

## Upper Lower Miocene Progradational Play

### LM4 P1, #2361

#### *Marginulina ascensionensis* and *Discorbis bolivarensis*

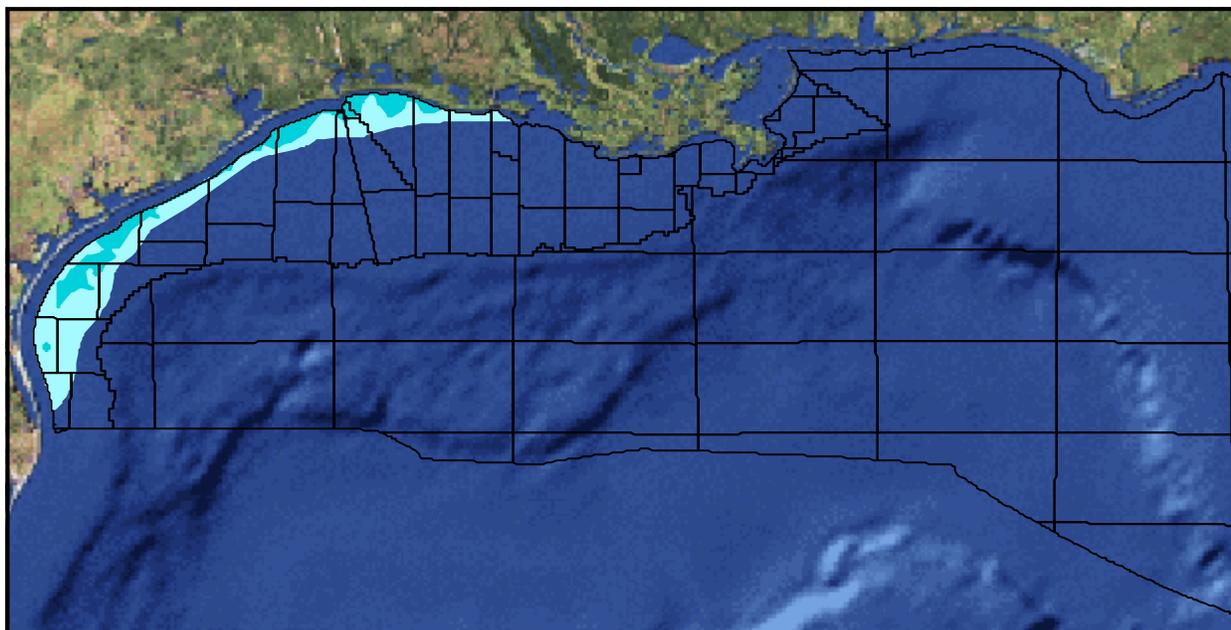


Figure 319. LM4 P1 map showing location of play. Play limit shown in light cyan; hydrocarbon limit shown in dark cyan.

## Overview

The Upper Lower Miocene Progradational Play (LM4 P1) contains reserves of 2,914.245 Bcfg and 36.622 MMbo (555.171 MMBOE) in 175 sands in 51 fields. The play extends continuously across the modern GOM shelf from the South Padre Island to South Marsh Island Area ([Figure 319](#)).

## Description

LM4 P1 is defined by (1) a progradational depositional style representing major regressive episodes in which sediments outbuild onto the shelf and slope and (2) the LM-3 and LM-4 Chronozones, the tops of which are defined by the *Marginulina ascensionensis* and *Discorbis bolivarensis* biozones, respectively ([Figure 8](#)).

LM4 P1 extends in a continuous band across the modern GOM shelf from the South Padre Island Area offshore Texas to the South Marsh Island Area offshore Louisiana ([Figure 319](#)). However, this band narrows considerably in width in the Federal OCS in the Brazos and Galveston Areas. Hydrocar-

bons have been encountered throughout most of the play area.

Depositional systems included the North Padre Delta System in the southern Texas area and the Calcasieu Delta System along the Texas-Louisiana border (Galloway et al., 1986). LM4 P1 extends laterally over a greater geographic area than does the older Middle Lower Miocene Progradational Play (LM2 P1), especially from the East Cameron through South Marsh Island Area. Progradational sands of LM4 time occur farther basinward than those deposited in either lower lower Miocene (LM1) or LM2 time. Additionally, LM4 time marks the first occurrence of both aggradational and retrogradational deposits in the Federal OCS.

## Play Limits

Updip and along strike, LM4 P1 continues onshore into Texas and Louisiana. LM4 P1 deposits grade into the sediments of the Upper Lower Miocene Fan 1 Play (LM4 F1) in a downdip direction.

## Depositional Style

Sediments deposited predominantly on the shelf characterize LM4 P1, with less common, generally finer-grained sediments deposited on the upper slope also occurring. These sediments represent major episodes in which outbuilding of both the shelf and the slope occurs.

The LM4 progradational interval varies from less than 100 to more than 5,900 ft in thickness. Individual sand-dominated successions range from tens of feet to about 1,000 ft in thickness. Shales with a thickness of from tens of feet to several hundred feet separate the sand-rich sequences. In the Brazos and Galveston Areas, progradational sediments are relatively sand poor and represent delta-fringe deposits at the most distal edges of the two LM4 delta systems. Progradational depositional facies, predominantly comprising distributary mouth bars, delta-fringe sediments, shelf blanket sands, and channel/levee complexes, characterize LM4 P1. These facies exhibit upward-coarsening (distributary mouth bars and delta fringe) and blocky to upward-fining (channel/levee complexes) log signatures. The thickest sand-dominated intervals probably represent stacked facies of multiple episodes of delta-lobe switching and progradation. The play less commonly contains delta slump deposits that exhibit a serrated, blocky log signature. Though unproductive in LM4 P1, crevasse splays that have an upward-fining log signature also occur.

## Structural Style

The majority of fields in LM4 P1 are structurally associated with normal faults. Other common structures are associated with shale diapirs, with traps on the flanks of the diapir or in sediment drape over the diapir, and growth faults with rollover traps. The least common structures include accumulations trapped by permeability barriers and updip pinchouts or facies changes, deep salt domes with traps on the flanks of the dome or in sediment drape over the dome, and rotational slump blocks.

## Quantitative Attributes

On the basis of reserves calculations, LM4 P1 contains 93% gas and 7% oil. The 175 sands in the play comprise 334 reservoirs, of which 315 are non-associated gas, 11 are undersaturated oil, and 8 are saturated oil. All reserves are proved and estimated

	No. of Sands	Oil (MMbbl)	Gas (Bcf)	BOE (MMbbl)
Proved	175	36.622	2,914.245	555.171
Cum. production	172	31.581	2,438.292	465.441
Remaining proved	88	5.041	475.953	89.730
Unproved	0	0.000	0.000	0.000

Table 153. LM4 P1 reserves and cumulative production.

to be 2,914.245 Bcfg and 36.622 MMbo (555.171 MMBOE) (Table 153). These reserves account for less than 82% of the reserves for the LM4 Chronozone.

Cumulative production from LM4 P1 totals 2,438.292 Bcfg and 31.581 MMbo (465.441 MMBOE) from 172 sands in all 51 fields in the play. This production accounts for 87% of the LM4 Chronozone's total production. Remaining proved reserves in the play are 475.953 Bcfg and 5.041 MMbo (89.730 MMBOE) in 88 sands in 37 fields.

Table 154 summarizes that water depths of the fields in LM4 P1 range from 29-156 ft, and play interval discovery depths vary from 6,190-14,170 ft, subsea. Additionally, porosity and water saturation range from 16-35% and 16-62%, respectively.

175 Sands	Min	Mean	Max
Water depth (ft)	29	67	156
Subsea depth (ft)	6,190	9,583	14,170
Reservoirs per sand	1	2	9
Porosity	16%	26%	35%
Water saturation	16%	30%	62%

Table 154. LM4 P1 sand attributes. Values are volume-weighted averages of individual reservoir attributes.

## Exploration History

LM4 P1 has a 50-year history of discoveries (Figure 320). The first sands in the play were discovered in 1949 in the West Cameron 45 Field. The maximum number of sands discovered in any year occurred in 1988 with 19 sands from eight fields, which also added the maximum yearly reserves of 85.807 MMBOE. Discoveries peaked in the 1980's, when 85 sands were added to the play.

The largest sand in the play was discovered in 1961 in the West Cameron 110 Field and contains an estimated 34.235 MMBOE (Figure 321). The mean sand size for the play is 3.172 MMBOE. Since the first Atlas database cutoff of January 1, 1995, 11 sands have been discovered, the largest of which is estimated to contain 5.075 MMBOE.

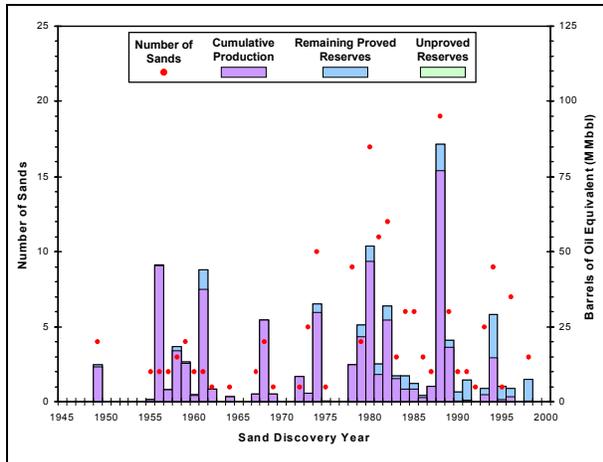


Figure 320. LM4 P1 exploration history graph showing reserves and number of sands discovered by year.

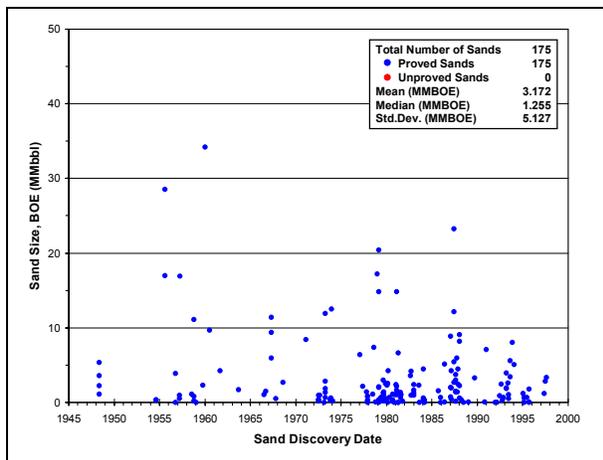


Figure 321. LM4 P1 sand discovery graph showing the size of sands discovered by year.

## Production History

LM4 P1 has a 44-year history of production (Figure 322). Production from the play began in 1954. Oil production peaked in the early 1970's, but remained fairly steady at a slightly lower level until 1990 when it began a decline. By 1998, LM4 P1 oil production had declined to 20% of its 1990 level. In contrast, LM4 P1 gas production exhibited an overall steady increase until the mid-1980's. Following a slight decline, the gas production peaked in 1990 as production from the peak discovery years of the 1980's came on line. Since then, LM4 P1 gas production has declined to 25% of its peak level.

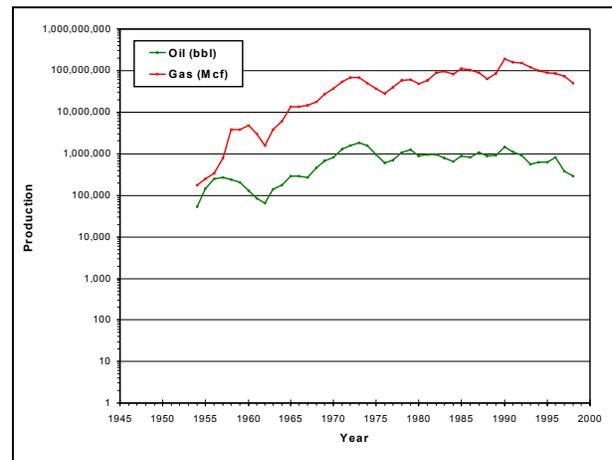


Figure 322. LM4 P1 production graph showing oil and gas production by year.